Reference & Program Instructions

12396

Model 485 Autoranging Picoammeter

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INTRODUCTION

This reference and programming guide contains condensed specifications and information which describes the various features of the Model 485. Each feature is described in three segments of information. The first segment describes the features. The second segment gives an exact procedure on how to use the feature. The third segment gives application examples. These segments are brief, but the information presented in this format is designed for a quick reference of the Model 485 features and functions. Refer to the Model 485 Instruction Manual for complete information and essential safety information.

With the Model 4853 IEEE-488 interface installed, the Model 485 can be controlled over the IEEE-488 bus. This booklet also contains information concerning Model 485 bus operation. Several example programs using some commonly used controllers are outlined to get the Model 485/4853 "up and running".

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CONDENSED SPECIFICATIONS

Range	Resolution	Accuracy (1 year) 18° -28°C ±(%rdg + counts)†	Maximum Continuous Input‡
2 nA	0.1pA	0.4 + 4	350Vdc
20 nA	1 pA	0.4 + 1	350Vdc
200 nA	10 pA	0.2 + 1	350Vdc
2 μA	100 nA	0.15 + 1	350Vdc
20 μA	1 nA	0.1 + 1	50Vdc
200 μA	10 nA	0.1 + 1	50Vdc
2mA	100 nA	0.1 + 1	50Vdc

†When properly zeroed.

‡With no limiting resistance: 1000Vdc with external 100kΩ series resistance.

INPUT VOLTAGE BURDEN: Less than 200μV.

RANGING: Manual or autoranging.

AUTORANGING TIME: 200ms per range.

SETTLING TIME AT DISPLAY: Less than 1sec to within 1 count after ranging.

CONVERSION PERIOD: 300ms.

TEMPERATURE COEFFICIENT: < ±0.1 × applicable accuracy specification per °C.

MAXIMUM COMMON MODE VOLTAGE: 30Vrms, DC to 60Hz sine wave.

ANALOG OUTPUT:

Output Voltage: +1V = −10000 counts. (Except +100mV = −10000 counts on 2nA range.)

Output Resistance: 1000Ω.

RELATIVE: Pushbutton allows zeroing of on range readings. Allows readings to be made with respect to baseline value. Front panel annunciator indicates REL mode.

DATA STORE and MIN/MAX: 100 reading storage capacity. Records data at one of seven selectable rates from 3rdgs/s to 1rdg/hr and manual triggering. Also detects and stores maximum and minimum readings continuously while in the data store mode.

LOG: Displays the logarithm (base 10) of the input current referenced to 1A.

SAFETY SYMBOLS AND TERMS

The symbol on the instrument denotes that user should refer to the operating section in the Model 485 Instruction Manual.

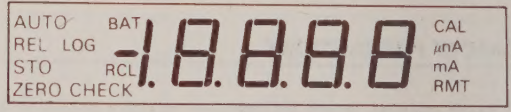
The **WARNING** used in this guide explains dangers that could result in personal injury or death.

SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a properly earth grounded power receptacle.
2. Before servicing, disconnect the instrument from the power line, all other equipment and consult the Model 485 Instruction Manual.
3. Do not touch the input terminal while the instrument is turned on or connected to any other test equipment. Common mode voltage may be present.

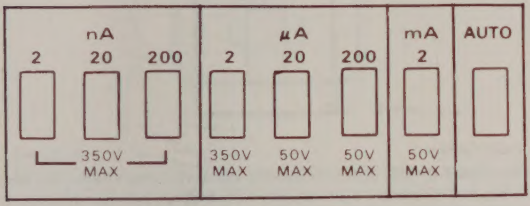
DISPLAY ANNUNCIATORS

The following annunciators are displayed on the LCD (Liquid Crystal Display)



AUTO—Indicates that the Model 485 is in the autorange mode.
REL—Indicates that the relative mode is selected. The reading is relative to some previous reading.
LOG—Log mode reading is directly in log (base 10).
STO—Indicates that the data store and min/max hold function is running. Displayed reading is present input.
RCL—Indicates that the displayed reading is recalled data.
BAT—Indicates that the battery requires recharging (operates only if the battery pack option Model 1758, is installed).
ZERO CHECK—Indicates that the Model 485 is in the zero check mode. Input impedance changes when in the zero check mode.
nA, μA or mA—Nanoamps, microamps or milliamps selected. Read measurement directly from the display. (e.g. 1.2345μA)
RMT—(Remote) Model 485 is being controlled over the IEEE-488 bus (Model 4853 installed).
CAL—Indicates that the Model 485 is in the calibration mode.

RANGE (2nA to 2mA)



Description

The range buttons select the desired range of current measurement for the Model 485. The range may be selected manually or automatically. With manual range selection always use the range that allows the greatest amount of resolution.

Operation

Manual

1. Determine signal to be measured.
2. Press appropriate range button.
3. Apply signal.

Auto

1. Press the AUTO button.
2. Apply signal.

ZERO CHECK

Description

The ZERO CHECK button is used to correct internal offsets and also protects the sensitive input circuitry from build up during overloads. In the zero check mode or input overload, the input impedance of the Model 485 is changed as outlined in the following table.

INPUT RESISTANCE WITH ZERO CHECK ENABLED

Current Range	Maximum Effective Input Resistance	Impedance In Zero Check/Overload
2 nA	100kΩ	9MΩ‖230pF
20 nA	10kΩ	9MΩ‖230pF
200 nA	1kΩ	5MΩ‖230pF
2 μA	100 Ω	900kΩ‖230pF
20 μA	10 Ω	100kΩ‖0.01μF
200 μA	1 Ω	10kΩ‖0.01μF
2mA	0.1 Ω	1kΩ‖0.01μF

Operation

1. Select range.
2. Depress ZERO CHECK. The ZERO CHECK button operates on the push-push principle. That is, pressing in the button locks the instrument in zero check, pressing the button again releases the zero check mode.

Typical Use

Used in zeroing the 2nA range for precise measurements. Refer to paragraph 2.7.2 in the Model 485 Instruction Manual.

REL (Relative Function)

Description

The relative function serves as a means of baseline suppression allowing a stored offset value to be subtracted from subsequent readings. When the REL button is pressed, the instrument stores the baseline reading with the next conversion. All subsequent readings represent the differences between the applied signal level and the stored baseline. The stored baseline can be as small as the resolution of the instrument will allow or as large as full range.

It is important to note that the REL function reduces the dynamic range of measurements by that level (stored baseline). For example: assume that the REL level is +1μA and the Model 485 is manually set to the 2μA range. The maximum positive displayed reading, before overranging, would be +0.9999μA. This is because the A/D converter would be seeing +1.9999μA to +0.9999μA (2.9998μA) as compared to the normal -1.9999μA to +1.9999μA (3.9998μA). Actually, the dynamic range is reduced by 1μA or 10,000 counts. The effects on dynamic range can be reduced by selecting a higher range or using autorange.

Operation

1. Select measurement mode and range. For example: normal measurement mode and the 2μA range.
2. Press REL. The display reads zero.
3. The value that appeared on the display is now the stored offset.

Typical Use

1. Nulling out external source offset (e.g. calibrator offset).
2. Nulling out desired levels of offset (e.g. electrode dark current of phototube).

Description

The log function gives the log (base 10) of the measured input current referenced to 1A. Log can be used to make any current level the 0.0 (zero) point for log measurements. This can be done by selecting autorange and log. Then measuring the desired current that is to be the 0.0 (zero) point. The logarithm is taken on the absolute value of the measurement so that both positive and negative currents can be displayed as a log. Press the REL button and the display will read 0.0 (zero). The measured current is now the 0.0 (zero) point for the log function. The mathematical equation for the log function is shown as follows:

$$\text{Display} = \text{Log}\left|\frac{\text{Input}}{1\ \text{Amp}}\right|$$

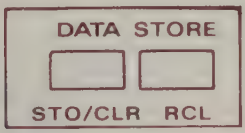
Operation (referenced to 1A)

1. Select the auto range mode.
2. Apply the source.
3. Press the LOG button. The LOG annunciator on the display turns on.
4. Take the log reading from the display.

Typical Use

1. For use in measuring a wide range of current. Nuclear reactors have various outputs of current that could be compressed (in readings only) by using the log function.
2. Measuring the current output of a phototube. REL can be used to null the dark current of the phototube.

DATA STORE (100 Point Data Store)



Description

The 100 point data store function serves to save up to 100 points of data at the rate of one of six selectable rates from every reading (3 per second) to one reading per hour. Also, manual data entry is available (R6). This feature is useful in applications where data is required to be logged over a period of time.

Operation

1. Connect desired measurement configuration to the Model 485.
2. Select rate of storage and begin data store:
   A. Press and hold in the STO/CLR button.
   B. The rates are scrolled on the display. (The rates are described below).
   C. Release the STO/CLR button when the desired rate is displayed.
   D. The STO annunciator turns on indicating that the data is being stored at the selected rate.

Typical Use

1. Saving data points of current drift of a low leakage device such as a FET.
2. Monitoring and saving current levels that fluctuate over a period of time.
   r = 0 (every reading)
   r = 1 (1 reading per second)
   r = 2 (1 reading per 10 seconds)
   r = 3 (1 reading per minute)
   r = 4 (1 reading per 10 minutes)
   r = 5 (1 reading per hour)
   r = 6 (every time STO/CLR is pressed)

STO/CLR (Store and Clear Function)

Description

The STO/CLR button is an internal part of the data store function. The button has several functions that are listed as follows:

1. Starts the data store operation.
2. Turns off the data store operation.
3. Selects the storage rate.
4. In the R6 data rate mode the STO/CLR button (when pressed) triggers the Model 485 to store a reading.
5. In the talk only mode, the STO/CLR button selects the talk rate. The store mode must be disabled for this function.

Operation

1. Press the STO/CLR button to start the data store operation (STO annunciator on the display is turn on). At this point the Model 485 starts storing readings.
2. Hold in the STO/CLR button to select the storage rate. The rates are scrolled on the display. Release the STO/CLR button when the desired rate is displayed.
3. Press the STO/CLR button to stop the data store operation. All data is retained until a new store cycle has commenced.
4. When in the R6 data rate mode, press the STO/CLR button each time a reading is to be stored. This data rate mode is used for custom rate data storage.
5. Using the IEEE interface the STO/CLR button can be used to select the talk rate. Refer to page 17.

RCL (Recall Function of DATA STORE)

Description

The RCL button is used to retrieve data that has been stored using the store/clear function.

Operation

1. Press and hold in the RCL button. The display scrolls through the data points and minimum/maximum readings. The first data point displayed is the last stored reading. The next two data points are the HI and LO readings made during that store cycle. Notice that the longer the RCL button is held in the faster the data points scroll on the display.
2. Release the RCL button at the desired data point and note the reading on the display. The data pointer can be incremented by steps of one by momentarily holding in the RCL button.
3. Turn off the data store by pressing the STO/CLR button. All stored data is retained until a new store cycle has commenced.

Min/Max HOLD

Description

The minimum/maximum hold feature detects and holds the highest and lowest readings while in the data store mode. This action is independent of the storage rate and runs at a rate of three readings per second. This function works in conjunction with the data store mode. The minimum and maximum readings are continuously updated while in the data store mode.

Operation

1. Use the data store mode to save a number of readings.
2. Press and hold in the RCL button. The display scrolls through the data points and the minimum/maximum points. The first data point displayed is the last data point that was stored. The next two data points are the maximum and minimum readings made during that store cycle.
3. Release the RCL button at the desired data point (min, max or normal data point) and note the reading on the display. The data pointer can be incremented by steps of one by momentarily holding in the RCL button.

Typical Use

Save up to 100 points of output current data along with the minimum and maximum readings of 1pA source that needs to be verified for calibration.

DIGITAL CALIBRATION

The digital calibration feature eliminates calibration potentiometers. All calibration factors for each range are stored in non-volatile RAM. The instrument can be calibrated from the front panel or with the optional 4853 IEEE interface. With the Model 4853 IEEE-488 interface installed, the Model 485 can be calibrated much faster using an automated system. Front panel digital calibration is outlined as follows:

NOTE

The following is an actual calibration procedure for the 20μA range. If recalibration is not necessary, then do not move the calibration jumper. Leave the jumper in the disable position. Refer to the Maintenance Section of the 485 Instruction Manual for jumper placement.

1. Move the calibration jumper to the enable position.
2. Turn on the Model 485.
3. Press the REL and LOG buttons simultaneously until the message "CAL" is displayed. Release the buttons. The Model 485 is now in the calibration mode as indicated by the "CAL" annunciator.
4. Apply the proper signal or level to the Model 485 input. Example: place the Model 485 to the 20μA range and apply 19.000μA.

NOTE

Consult the Model 485 Instruction Manual for detailed methods of creating the proper calibration levels.

5. Adjust the display accordingly with the use of the STO/CLR and RCL buttons. The STO/CLR button increments the displayed reading. The RCL button decrements the displayed reading.
6. Press the LOG and REL button simultaneously until the message "STOR" is displayed. The "new" calibration point for the 20μA range is now permanently stored. This new constant remains as is until changed.
7. To return to normal operation, turn off the instrument momentarily, then back on.
8. Turn the instrument off and place the calibration jumper in the disable position to prevent inadvertent calibration of the instrument.

Consult the Model 485 Instruction Manual for complete details concerning Model 485 calibration. The preceding procedure is presented here to remind the user that front panel digital calibration is available on the Model 485.

IEEE-488 option: Allows the user to calibrate the instrument over the IEEE-488 bus. With the IEEE-488 interface installed (option 4853), the Model 485 can be calibrated on most automated calibration systems.

IEEE-488 PROGRAMMING

The Keithley Model 485 has an optional IEEE-488 interface (Model 4853) which can be included with the instrument or added later. Inclusion of the interface option is apparent by the connector and address switch at the rear panel. The field installable option kit includes a replacement top cover with appropriate access openings on the rear panel. The following lists all the commands available to the Model 485.

RANGE:	R0 = Auto Range (R0 ignored in calibration mode)
	R1 = 2 nA
	R2 = 20 nA
	R3 = 200 nA
	R4 = 2 μA
	R5 = 20 μA
	R6 = 200 μA
	R7 = 2mA
LOG:	D0 = Off
	D1 = On
RELATIVE:	Z0 = Off
	Z1 = On
ZERO CHECK:	C0 = Off
	C1 = On
TRIGGER:	T0 = Continuous on Talk
	T1 = One-shot on Talk
	T2 = Continuous on GET
	T3 = One-shot on GET
	T4 = Continuous on "X"
	T5 = One-shot on "X"
EOI:	K0 = EOI is transmitted on the last byte out.
	K1 = EOI is not transmitted.
STORE:	L0 = Store Calibration Constants
DIGITAL CALIBRATION:	V + n.nnnnE + nn n = Calibration Value
SRQ:	Mnnn nnn = 0 to 255 (base 10) M0 = Clear SRQ data mask M1 = Reading Overflow M8 = Reading Done M9 = Reading Done or Reading Overflow

M16 = Busy
M17 = Busy or Reading Overflow
M24 = Busy or Reading Done
M25 = Busy, Reading Done or Reading Overflow
M32 = Clear SRQ error mask
M33 = IDDCO
M34 = IDDC
M35 = IDDC or IDDCO
M36 = Not in Remote
M37 = Not in Remote or IDDCO
M38 = Not in Remote or IDDC
M39 = Not in Remote, IDDC or IDDCO

STATUS WORD: U0 = Output Status Word on next read.

DATA FORMAT: G0 = Send Prefix
G1 = Do Not Send Prefix

TERMINATOR: Y(ASCII) = ASCII character
Y(CR LF) = CR LF
Y(LF CR) = LF CR
Y(X) = None

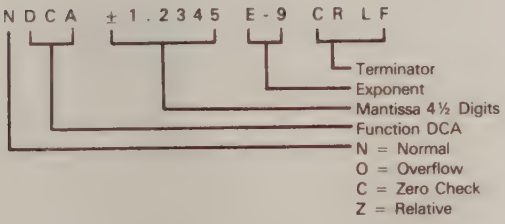
EXECUTE: X = Execute other device-dependent commands.

POWER UP DEFAULT CONDITIONS

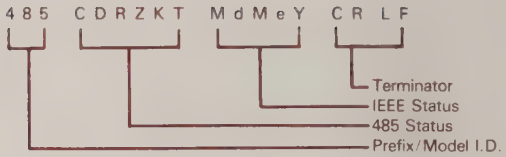
MODE	VALUE/STATUS
DATA STORE	Turned Off
RANGE	Reflects Front Panel Buttons
ZERO CHECK	Reflects Front Panel Button
LOG	(D0) Off
RELATIVE	(Z0) Off
CALIBRATION MODE	Off
TRIGGER	(T0) Continuous on Talk
EOI	(K0) EOI is transmitted on last byte out.
SRQ	(M000) No SRQ
ALTERNATE OUTPUT	Standard Output
DATA FORMAT	(G0) Prefix Enabled
TERMINATOR	(CR) (LF)

MODEL 4853 PRIMARY ADDRESS SWITCH SET AT 22 (10110)

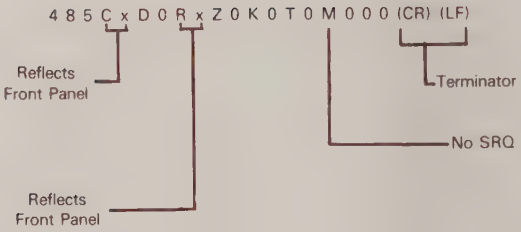
DATA FORMAT:
(Reading)



STATUS:



DEFAULT:



Talk Only Operation

Description

The talk only mode may be used to send data to a listen only device such as a printer. When the Model 485 is in the talk only mode, it ignores commands given over the bus. The talk only mode is enabled by placing the TO/ADDRSSABLE switch in the TO position and then cycling power to the instrument. The default talk rate is three readings per second (every reading). However, a different talk rate can be selected by performing the following procedure.

Operation

1. Enable the talk only mode. Cycle power to the instrument.
2. Press and hold in the STO/CLR button. The following talk rates scroll on the display:
   r = 0 (every reading)
   r = 1 (1 reading per second)
   r = 2 (1 reading per 10 seconds)
   r = 3 (1 reading per minute)
   r = 4 (1 reading per 10 minutes)
   r = 5 (1 reading per hour)
   r = 6 (1 reading per every time STO/CLR is pressed)
3. Release the STO/CLR button when the desired talk rate is displayed. At this point the STO annunciator appears on the display indicating that the instrument is talking at the selected rate.
4. Turn off the data store operation by pressing the STO/CLR button. Notice that the STO annunciator turns off.

NOTE

The instrument remains in the selected talk rate until a new rate is selected or power is cycled.

PROGRAMS

The following programs are designed to be a simple aid to the user. They are not intended to suit specific needs. Detailed programming information can be found in the manual.

These programs display one reading at the output of the controller. The program provides an ASCII string variable output of the form:

NDCA + 0.0000+0 CR LF

The note at the end of each program indicates modifications to provide a numeric variable (A) in exponential form:

+0.0000+0

IBM PERSONAL COMPUTER XT or PC
(Keithley Instruments Model 8573 GPIB Interface)

The following program sends a command string to the Model 485 from an IBM PC or XT computer and displays the instrument reading on the CRT. The computer must be equipped with a Keithley Instruments Model 8573 GPIB IEEE interface and the DOS 2.0 operating system. The GPIB software and hardware must be configured per the Keithley Instruments Model 8573 Instruction Manual.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. With the power off, connect the Model 485 to the IEEE-488 interface installed in the IBM computer.
3. Using the interface software IBCONF program, set up the GPIB.COM handler so that "DEV22" has a primary address of 22. Again, consult the interface board instruction manual for complete details.
4. Place the instrument software disc in the default drive, type LOAD "DECL", and press the return key.
5. Enter the following program into the computer, pressing the return key after each line is typed. Lines 1—6 are part of the DECL program previously loaded and need not be typed in.
6. Run the program and type in the desired command string when prompted. For example: to place the Model 485 into the one shot on talk trigger mode and in the 2μA range, type in T1R4X and press the return key.
7. The display will show the Model 485 reading string on the CRT. For example: when the Model 485 is in Zero Check, the display will read NDCA + 0.0000E—6.
8. To exit the program type EXIT and press return.

PROGRAM

```
1 CLEAR ,16000!
2 IBINIT1 = 16000!

3 IBINIT2 = IBINIT1 + 3
4 BLOAD "BIB.M"IBINIT1
5 CALL IBINIT1(IBFIND,IBTRG,
  BCLR,IBPCT,IBSIC,IBLOC,
  IBPPC,IBBNA,IBONL,IBRSC,
  IBSRE,IBRSV,IBPAD,IBSAD,
  IBIST,IBDMA,IBEOS,IBTMO,
  IBEOT)
6 CALL IBINIT2(IBGTS,IBCAC,
  IBWAIT,IBPOKE,IBWRT,
  IBWRTA,IBCMD,IBCMDA,
```

COMMENTS

GPIB-PC Rev. B.0
IBM BASICA Declaration File.

```
    IBRD,IBRDA,IBSTOP,IBRPP,
    IBRSP,IBDIAG,IBXTRC,
    IBSTA%,IBERR%,IBCNT%)
 10 CLS
 20 NA$="GPIB0":CALL IBFIND          Find the board number.
    (NA$,BRD0%)
 30 NA$="DEV15":CALL IBFIND          Find the 485 number.
    (NA$,M485%)
 40 V%=22:CALL IBPAD                 Change to primary address
    (M485%,V%)                       22.
 50 V%=1:CALL IBSRE                  Set REN true.
    (BRD0%,V%)
 60 INPUT"COMMAND";CMD$              Prompt for command
                                     string.
 70 IF CMD$="EXIT" THEN 140          See if program is to be
                                     halted.
 80 IF CMD$="" THEN 60               If null command string go
                                     back and get another.
 90 CALL IBWRT(M485%,CMD$)           Address 485 to listen and
                                     send command string.
100 RD$=SPACE$(50)                   Assign reading input buffer.
105 CALL IBRD (M485%, RD$)
110 RD$=LEFT$(RD$,IBCNT%)            Trim string to proper size
120 PRINT RD$                        Display the reading on the
                                     CRT
130 GOTO 120                         Repeat
140 V%=0:CALL IBONL                  Close the board file.
    (M485%,V%)
150 CALL IBONL(M485%,V%)             Close the instrument file.
160 END
```

NOTE: Lines 1—6 of this program need not be typed in. They are contained on the floppy disc. When the command LOAD"DECL" is entered, these lines are already there.

NOTE: If conversion to numeric variable is desired, change lines 110 and 120 as follows:

```
110 RD=VAL(MID$(RD$,5,14))
120 PRINT RD
```

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on th APPLE II screen, using an APPLE IEEE-488 interface.

DIRECTIONS

1. Using the rear panel switches, set the primary address of the Model 485 to 22 (10110).
2. Connect the Model 485 to the APPLE II and APPLE IEEE-488 interface.
3. Enter the following program using the RETURN key after each line.
4. Type in RUN and depress the RETURN key.
5. The display will read "TEST SETUP".
6. To program the Model 485 to the 2μA range and take a reading type in R4T1X and depress the RETURN key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
10 DIM A$(20),B$(20)	Dimension data string.
20 Z$ = CHR$(26)	Terminator
30 INPUT"TEST SETUP?";B$	Enter programming command. Example: 2μA range = R4T1X
40 PR#3	Send output to IEEE bus.
50 IN#3	Get input from IEEE bus.
60 PRINT "RA"	Turn remote on.
70 PRINT "WT6";Z$;B$	Write B$ to 485.
80 PRINT "LF1"	Linefeed On
90 PRINT "RDV";Z$;:INPUT " "; A$	Read data from 485.
100 PRINT "UT"	
110 PR#0	Send output to CRT.
120 IN#0	Get input from keyboard.
130 PRINT A$	
140 GO TO 30	Repeat

NOTE: If conversion to numeric variable is needed, add the following:

```
134 A = VAL(MID$(A$,5,11))
136 PRINT A
```

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the HP-85 CRT screen, using the 82937A GPIB interface and an I/O ROM.

DIRECTIONS

1. Using the rear panel switches set the primary address on the Model 485 to 22 (10110).
2. Connect the Model 485 to the HP 82937A IEEE interface.
3. Enter the following program using the END LINE key after each line is typed.
4. Depress the RUN key.
5. The display will read "TEST SETUP".
6. To program the Model 485 to the 2μA range and take a reading, type in R4T1X and depress the END LINE key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
10 REMOTE 722	Set to remote.
20 DISP "TEST SETUP"	Prompt for test setup.
30 INPUT B$	
40 OUTPUT 722;B$	Prompt the 485.
50 ENTER 722;A$	Get data from 485.
60 DISPA$	
70 GO TO 20	Repeat
80 END	

NOTE: If conversion to numeric variable is needed, change line 60 as follows:

```
60 DISP VAL(A$[5])
```

HP 9825A

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the HP 9825A using a 98034A HPIB interface and a 9872A extended I/O ROM.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. Connect the Model 485 to HP 9825A and 98034A HPIB interface.
3. Enter the following program using the STORE key after each line is typed. Line numbers are automatically assigned by the 9825A.
4. Depress the RUN key.
5. The display will read "TEST SETUP".
6. To program the Model 485 to the 2μA range and take a reading, type in R4T1X and depress the CONTINUE key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
0 dim A$[20],B$[20]	Dimension data strings.
1 dev"485",722	Define Model 485 address 22.
2 rem"485"	Set to remote.
3 ent"TEST SETUP",B$	Enter programming command. (Example: 2μA range= R4T1X)
4 wrt"485",B$	Output program command to Model 485 via IEEE bus.
5 red"485",A$	Read data from Model 485 via IEEE bus.
6 prt A$	Print data on hard copy printer.
7 gto 3	Repeat.

NOTE: If conversion to numeric variable is desired, omit line 6 and 7 and substitute:

6 "e" → A$[13,13];fltt5	Convert to numeric variable.
7 prt val(A$[5])	
8 gto 3	Repeat

The following program sends a command string to the Model 485 Picoammeter, reads data and displays the data on the HP 9816 CRT, using BASIC 2.0.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. With the power off, connect the Model 485 to the HP 9816 and HP 82937A GPIB interface.
3. Type EDIT and press the EXEC key.
4. Enter the following program using the ENTER key after each line is typed.
5. Press the HP 9816 RUN key.
6. The display will read "TEST SETUP".
7. To program the Model 485 to the 2μA range and to take a reading type in R4X and press the ENTER key.
8. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
10 REMOTE 722	Set to remote.
20 INPUT"TEST SETUP",A$	Prompt for test setup,
30 OUTPUT 722;A$	Send command string to 485.
40 ENTER 722;B$	Get data string from 485.
50 PRINT B$	Display data string.
60 GO TO 20	Repeat
70 END	

NOTE: If conversion to numeric variable is desired, change lines 40 and 50 as follows:

```
40 ENTER 722;B
50 PRINT B
```

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the 9845B screen using a 98034A HPIB interface and an I/O ROM.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. Connect the Model 485 to the HP 9845B and the 98034A interface.
3. Enter the following program using the STORE key after each line.
4. Depress the RUN key.
5. The display will read "TEST SETUP" in the lower left corner.
6. To program the Model 485 to the 2μA range and take a reading type in R4T1X and press the EXECUTE key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
10 DIM A$[20], B$[20]	
20 E485 = 722	Define Model 485 address 22.
30 INPUT"TEST SETUP",B$	Enter programming command (Example: 2μA range = R4T1X).
40 OUTPUT E485;B$	Output program command to Model 485 via IEEE bus.
50 ENTER E485;A$	Read data from 485 via IEEE bus.
60 PRINT A$	Print data on 9845B CRT.
70 GO TO 30	Repeat

NOTE: If conversion to numeric variable is desired, omit line 60 and substitute:

60 PRINT VAL(A$[5,11])	Convert string to numeric value.
70 GO TO 30	Repeat

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the TEK 4052 graphics terminal, with a 4051 GPIB interface.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. Connect the Model 485 to the TEK 4051 IEEE interface.
3. Enter the following program using the RETURN key after each line.
4. Type in RUN.
5. The display will read "TEST SETUP".
6. To program the Model 485 to the 2μA range and take a reading, type in R4T1X and press the RETURN key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
5 PRINT @ 37, 0: 10, 255, 13	
10 PRINT "TEST SETUP"	Prompt for the test setup.
20 PRINT B$	
30 PRINT @ 22: B$	Program the Model 485.
40 INPUT % 22: A$	Get data from the Model 485.
50 PRINT A$	
60 GO TO 10	Repeat

NOTE: If conversion to numeric variable is desired, change lines 40 and 50 to:

```
40 INPUT % 22: A
50 PRINT A
```

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the DEC LSI 11 microcomputer CRT terminal. The LSI 11 must be configured with 16k words of RAM and an IBV 11 IEEE interface. The software must be configured with IB software as well as the FORTRAN and the RT 11 operating system.

DIRECTIONS

1. Using the rear panel switches set the primary address on the Model 485 to 22 (10110).
2. Connect the Model 485 to the IBV 11 IEEE cable.
3. Enter the following program, using the editor under RT 11 and the name IPHILD.
4. Compile using the fortran compiler as follows: FORTRAN IPHILD.
5. Link with the system and IB libraries as follows: LINK IPHILD,IBLIB.
6. Type RUN IPHILD and depress the RETURN key.
7. The display will read "ENTER ADDRESS".
8. Type in 22 and depress the RETURN key.
9. The display will read "TEST SETUP".
10. To program the Model 485 to the 2μA range and take a reading, type in R4T1X and depress the RETURN key.
11. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

```
PROGRAM                          COMMENTS
   INTEGER*2 PRIADR
   LOGICAL*1MSG(80),INPUT(80)
   DO 2 I = 1,10
   CALL IBSTER(I,0)              !Turn off IB errors.
 2 CONTINUE
   CALL IBSTER (15,5)            !Allow 5 errors 15's.
   CALL IBTIMO (120)             !Allow 1 second bus
                                  timeout.
   CALL IBTERM ("10)             !Set LF as terminator.
   CALL IBREN                    !Turn remote on.
 4 TYPE 5
 5 FORMAT (1X,'ENTER              !Input the address 22.
   ADDRESS',$) ACCEPT
   10, PRIADR
10 FORMAT (214)
12 TYPE 15
15 FORMAT (1X,'TEST SETUP',$)    !Prompt for the test setup.
   CALL GETSTR (5,MSG,72)        !Get the test setup.
   CALL IBSEOI (MSG,-1 PRIADR)   !Program the 485.
```

```
18 I=IBRECV (INPUT,80,PRIADR)
   INPUT (I + 1) = 0
   CALL PUTSTR (7,INPUT,'0')
   CALL IBUNT                    !Untalk the 485.
   GO TO 12                      !Repeat
   END
```

The following program obtains one reading from the Model 485 Picoammeter and displays the reading on the PET/CBM 2001 screen.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. Connect the Model 485 to the PET/CBM 2001 IEEE interface.
3. Enter the following program using the RETURN key after each line.
4. Type RUN and depress the RETURN key.
5. The display will read "TEST SETUP".
6. To program the Model 485 to the 2μA range and take a reading, type in R4T1X and depress the RETURN key.
7. The display will read NDCA + 0.0000E−6 when the Model 485 is in Zero Check.

PROGRAM	COMMENTS
10 OPEN 6,22	Open file 6, primary address 22.
20 INPUT "TEST SETUP";B$	Enter programming command. (Example: 2μA range = R4T1X).
30 PRINT#6,B$	Output to IEEE bus.
40 INPUT#6,A$	Read data from Model 485 via IEEE bus.
50 IF ST = 2 THEN 40	If time out, input again.
60 PRINT A$	Print data.
70 GO TO 20	Repeat

NOTE: If conversion to numeric variable is desired, omit line 70 and type the following:

70 A = VAL(MID$(A$,5,15))	Convert to numeric variable.
80 PRINT "A=" ;A	
90 GO TO 20	Repeat

E-H 7000 COMPUTER

The following program sends a data string from the E-H computer to the Model 485 Picoammeter and then displays the instrument reading on the computer CRT. The E-H 7000 must be configured with MS-DOS and BASICA as outlined in its instruction manual.

DIRECTIONS

1. Using the rear panel switches set the primary address of the Model 485 to 22 (10110).
2. With the power off, connect the Model 485 to PORT 1 of the computer.
3. While in BASICA, type LOAD "EHE488.CMP" to load the GPIB handler software.
4. Add the lines below to the front of the program now in memory; press the return key after each line is typed. The complete program including the GPIB handler software may now be saved in the usual manner.
5. Press the computer F2 key to run the program. The CRT will prompt with COMMAND?.
6. Type in the desired command. For example: To program the instrument to the 2μA range and take a reading, type in R4T1X and press the return key.
7. The computer CRT will then display the instrument's data string on the CRT. For example: with the Model 485 on the 2μA range and with Zero Check enabled, the data string reads NDCA + 0.0000E−6.

PROGRAM	COMMENTS
10 CLS	
20 GOSUB 65010	'Initialize handler software.
30 CALL PORT1	'Initialize Port 1.
40 CALL INIT	'Initialize interface.
50 DEV$ = "22 "	'Primary address = 22.
60 INPUT "COMMAND";C$	'Prompt for command string.
70 IF C$ = " " THEN 60	'If null input go back.
80 IN$ = SPACE$ (20)	'Define reading buffer.
90 CALL SNDSTR(DEV$,C$)	'Send command string to 485.
100 CALL RCVSTR(DEV$,IN$)	'Get reading from 485.
110 PRINT IN$	'Display reading string on CRT.
120 GO TO 60	'Repeat

NOTE: For conversion to numeric variable, change line 110 to:

110 PRINT VAL(MID$(IN$,5,152))

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